USGS

Teacher Guide

Global change is a relatively new area of scientific study using research from many disciplines to determine how Earth systems change, and to assess the influence of human activity on these changes.

This teaching packet consists of a poster and three activity sheets. In teaching these activities four themes are important: **time, change, cycles,** and **Earth as home.**

The poster

The front of the poster uses metaphor to invite students to think about the Earth as a whole and to respect its fragility. The back of the poster shows visible global change.

The **tree-ring** image can be used in the "Logs of Straws" activity. Have the students assume the tree was cut down in 1992. Have them calculate the age of the tree and measure the rings to see which years had favorable climatic conditions and which had unfavorable conditions.

The **Keeling curve** relates to the activity, "Where Land, Air, and Water Meet." It shows students how data can be visualized to detect patterns: both the upward trend in the atmospheric concentration of carbon dioxide, and cyclical fluctuations during the growing season.

The **greenness maps** depict the vigor of vegetation and allow scientists to see how vegetation changes over a growing season and from year to year. Because plants remove carbon dioxide from the atmosphere, such maps may be useful for describing how gases are transferred between the biosphere and the atmosphere.

In the final activity, "An island Home," students can be asked: What happens to an ecosystem when much of the vegetation is removed? Satellite images such as those from **the Brazilian rainforest,** show human alteration of the landscape. How could the destruction of the rain forest affect the global environment?

Activities

Each of three activities, ("Logs of Straws: Dendrochronology," "Where Land, Air, and Water Meet," and "An Island Home") includes background material, an experiment, suggestions for further reading, and extensions. Activities can be presented in any order, but "An island Home" could be used as a summary.

The four themes

Time

Looking back over the millions of years of the Earth's history, scientists have found evidence of times when climates were very different from today's. Scientists know from fossil records that certain pine trees growing today in Nova Scotia, Canada, once grew more than 1,500 miles farther north on an island near the Arctic Circle. Students will work with simulated tree rings to discover how records of natural phenomena are used to reconstruct past climates

Change

One demonstrable variation in Earth's atmosphere has been the increase in concentration of carbon dioxide (CO,) gas during the past century. "Where Land, Air, and Water Meet" introduces students to measurement in parts per million and concentration. This activity can lead to a discussion of the composition of the atmosphere and of how solar radiation, vegetation, and human activity could influence global warming.

Cycles

Many natural phenomena vary on a regular or periodic basis. An example of this is the changing seasons. Some of the images on the back of the poster demonstrate natural cycles. The concentration of CO_2, in the atmosphere fluctuates regularly with the seasons. Temperature records reveal a history of thermal cycles in the Earth's climate. Students should be asked to consider cycles and to discuss how cyclical change can be distinguished from change that moves in only one direction.

The Earth as home

"An island Home" is an open-ended activity in which students consider how altering part of an ecosystem can cause changes to other parts of the system. This activity uses concepts developed in the other activities to help students look on the Earth as home, and encourage responsible stewardship.

Readings for teachers

The following books and articles are recommended for more information about global environmental change issues:

de Blij, H.J., editor, 1988, Earth '88—Changing geographic perspectives: Washington, D.C., National Geographic Society, 392 p.

Jastrow, W., Nierenberg, W., and Seitz, F., 1990, Scientific perspectives on the greenhouse problem Ottawa, Illinois, Jameson Books, 250 p.

Levenson, Thomas, 1989, Ice time: New York Harper and Row, 229 p.

Lins, H.F., Sundquist, E.T., and Ager, T.A., 1988, Information on selected climate and climate change issues: U.S. Geological Survey, Open-File Report 88-718, 26 p.

Lovelock, J.E., 1979, Gaia—A new look at life on Earth: Oxford, Oxford University Press, 157 p.

Revelle, Roger, 1982, Carbon dioxide and world climate: Scientific American, v. 247, no. 2, p. 35-43.

Schneider, Stephen H., 1989, Global warming—Are we entering the greenhouse century?: San Francisco, Sierra Club Books, 317 p.

Scientific American, 1989, Managing planet Earth: Scientific American, v. 261, no. 3, p. 47-190.

Stevens, P.R., and Kelley, K.W., 1992, Embracing Earth: San Francisco, Chronicle Books, 176 p.

Weiner, Jonathan, 1968, Planet Earth: New York, Bantam, 370 p.

Zaburunov, Steven A., 1992, As the world breathes—The carbon dioxide cycle: Earth, v.1, no.1, p. 26-33.

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For more information

To find out more about research being done on global change by the USGS or about other USGS educational materials call 1-888-ASK-USGS.